Data Center Efficiency
&
Going Green with NetApp

Shanmugam Ramu
Head - Workplace Resources
NetApp, India

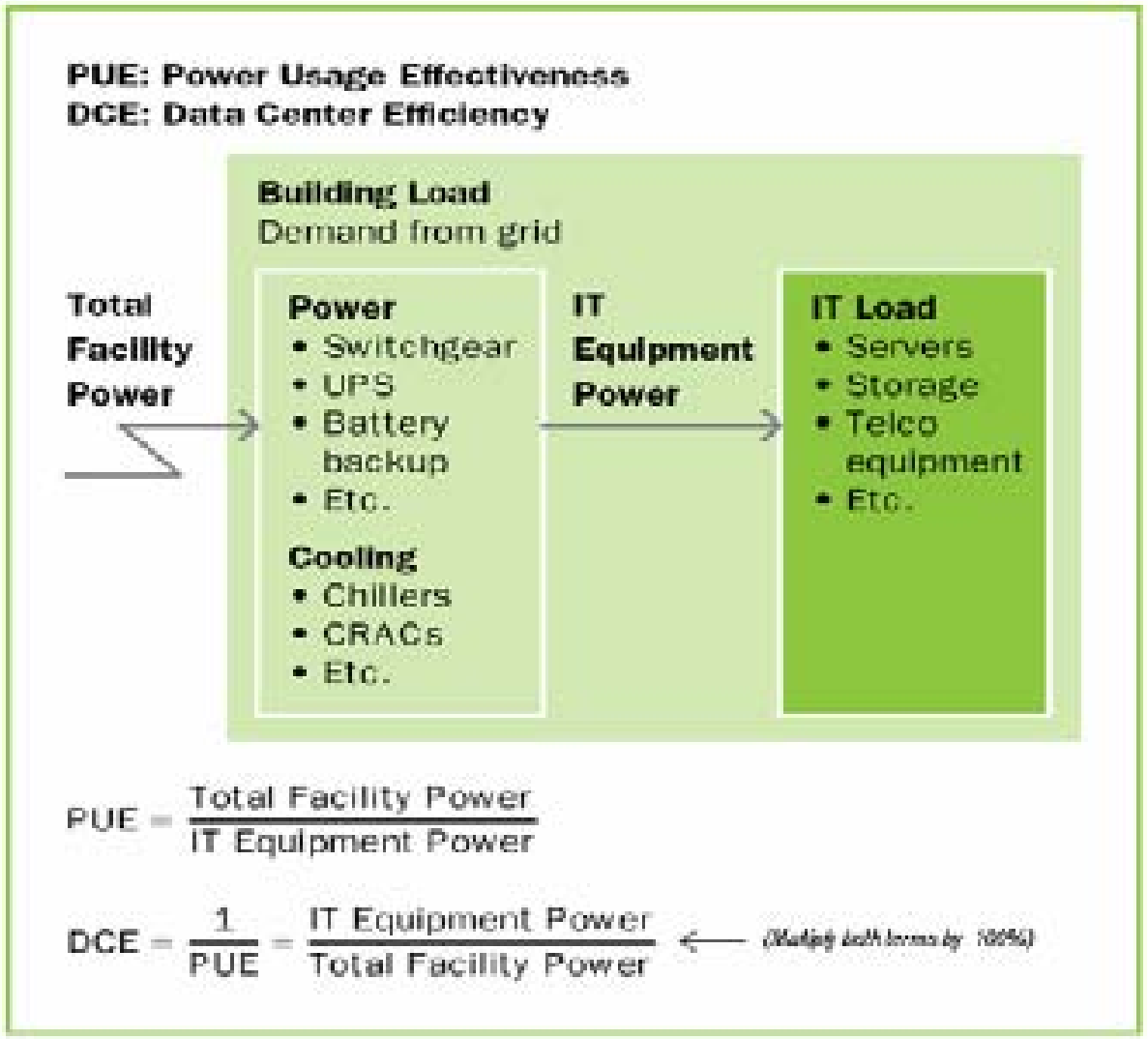
Today's Data Center Challenges

- Reliability
- Uptime
- Scalability
- Efficiency / Cost
- Corporate Social Responsibility

So what's the right Power / Cooling Design?

What is PUE Ratio?

- **EPA (U.S.Environmental protection Agency) has set standards for effective usage of power for mission critical Data centers**



PUE Ratio at NetApp, India Data Center

- **3rd Floor, 192 rack Data Center without cold room**

  - PUE Ratio : 1.65 (Online since Feb 06)

- **4th Floor, 203 rack Data Center with cold rooms & blanking plates (only 25% Racks populated)**

  - PUE ratio : 1.85 (Online since Sep 07)

*** EPA predicts 2011 maximum achievable PUE = 1.20**

EPA Assumed PUE Ratio by Space Type and Year, State-of-the-Art Scenario, 2007 to 2011

Space type	2007	2008	2009	2010	2011
Enterprise-class data center	1.89	1.78	1.67	1.56	1.45

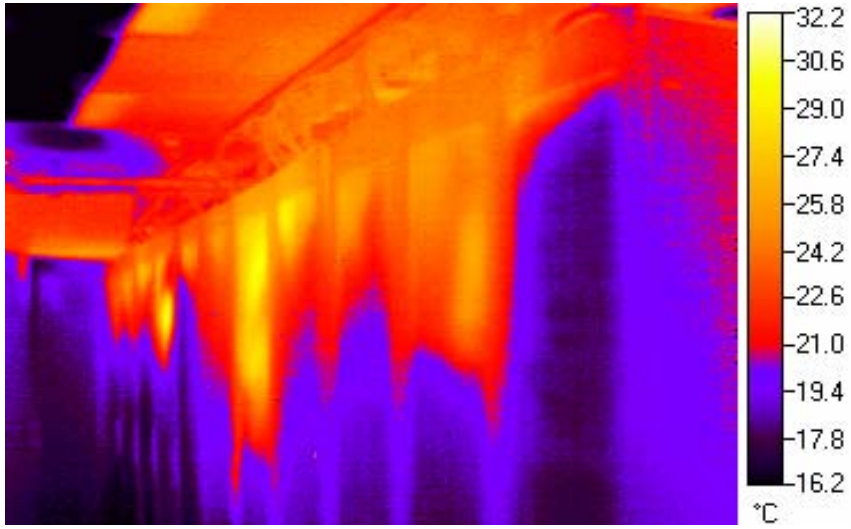
EPA Datacenter Report Final Appendices

3rd Floor Data Center

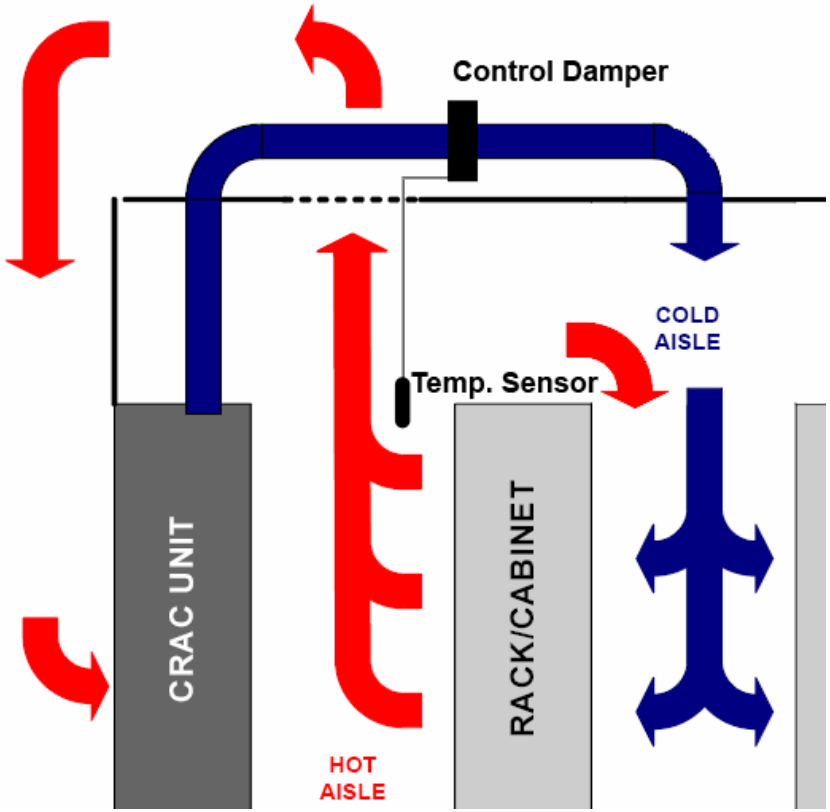
- 4 kW / rack power capacity for 192 racks
- PUE ratio = 1.65
- Variable Frequency Drive Control to reduce Power Consumption
- Cold aisle damper controlled trough Manual valves.

- Positives
  - Common air-handling header = N+1 redundancy
  - VFD to reduce fan horsepower

- Negatives
  - Venturi effect draws hot air into cold row
  - Manual Control of valves to control the temperature



Infrared Imagery of datacenter without cold aisle concept



NetApp Data Center at RTP, North Carolina

4th Floor Data Center

- 4 kW / rack power capacity for 192 racks (24 DC Racks in a separate room)
- PUE ratio = 1.85 (Labs not fully occupied)
- Modulating damper supplies enclosed pressure-controlled room
- Positives
  - Reduced air mixing
    - Reduced fan horsepower
    - Greater cooling capacity
    - Elimination of hot spots
  - Common air-handling header with N+1 redundancy
  - Quiet - less intense than third floor lab
- Negatives
  - All airflow must be cold to hot
  - All empty U must be covered with plates
  - All entry doors must be closed when not in use

Cold Aisle

Hot Aisle

RTP Building One, First-Floor Lab

- **8 kW / rack power capacity for 360 racks**
- **PUE ratio = 1.37**
- Modulating damper supplies enclosed pressure-controlled room
- Positives
  - Reduced air mixing = reduced fan horsepower
  - Reduced air mixing = greater cooling capacity
  - Reduced air mixing = elimination of hot spots
  - Common air-handling header = N+1 redundancy
  - Quiet; 10x less intense than second-floor lab
- Negatives
  - Unable to bring in outside air for economizer cooling
  - All airflow must be cold to hot
  - All empty U must be covered with plates
  - All entry doors must be closed when not in use

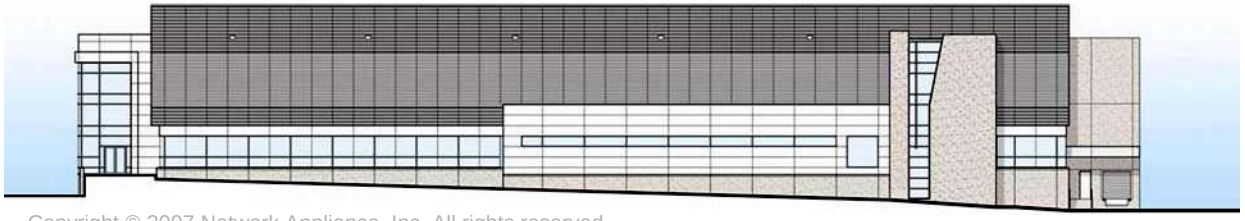
Infrared shows very uniform temperatures.
Warm areas from not covering empty rack space.

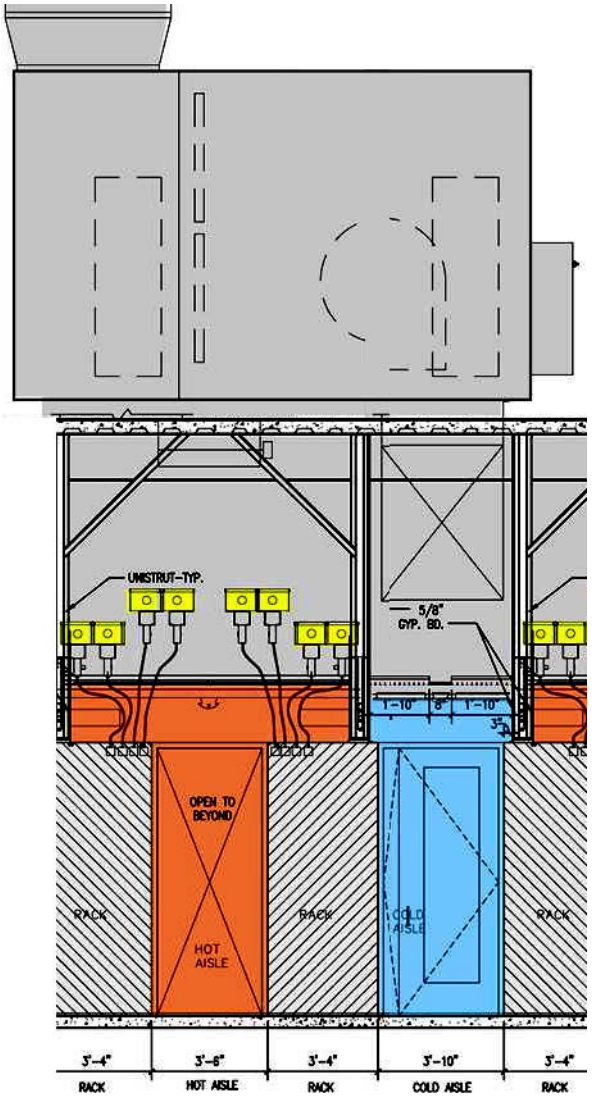
Hot aisle

Cold room

RTP Building Four Dedicated Lab Building

- **12 kW / rack power capacity for 2,160 racks**
- **PUE ratio = 1.20**
- 36mW total building power capacity
- $12 million annual electric bill when fully populated (4.5 cents/kWh)
- Modulating fan supplies enclosed pressure-controlled room
- **Positives**
  - Raised supply temperature set point
    - Increased chiller efficiency 17%
    - Increased hours of outside air economizer cooling
    - $2 million annual savings in cooling energy cost
    - CO2 reduced by 40,000 tons/year = 7,000 cars not driven for 1 year
  - Air-handling units directly over cold room reduce fan horsepower
  - Reclaimed (treated city waste) water used for cooling tower makeup
    - $100,000 annual savings in water cost
  - Outside air economizer adds redundancy for chiller plant failure
- **Negatives**
  - All airflow must be cold to hot
  - All empty U must be covered with plates
  - All entry doors must be closed when not in use





High Lights of the New Design

- Separate Cold room / Hot aisle concept
- No Raised Floor
- No CRAC unit's inside the DC (no risk of flooding)
- Multiple Air Handling units offering N+1 Redundancy
- Brine Chillers Installed (Ethylene Glycol)
- NetApp uses new methods with existing cooling technologies
  - Modulating damper supplies enclosed pressure-controlled room
- NetApp takes advantage of wide operating temperature and humidity set points
  - Set points are within manufacturers' operating limits
  - Set points are within allowable levels published in ***Thermal Guidelines for Data Processing Environments*** by ASHRAE

Going Forward…..

- Separate Cold room / Hot room enclosures
- Plain metal ceilings in the cold room
- Evaluate Man trap entrances
- Evaluate and Install Solar lighting
- Connect AHU's and pumps to UPS therby offering increased set point temperature
- New ideas to be explored …….

White Papers

- **Reducing datacenter power consumption**

  http://www.netapp.com/ftp/wp-reducing-datacenter-power-consumption.pdf

- **Data ONTAP – Consolidate storage**

  www.netapp.com/tech_library/ftp/3356.pdf

A Case Study

Going Green
with NetApp

What Customers Are Facing

Drivers

- **Regulatory**
- **Multiple Copies**
- **Internet**
- **Source-points**
- **Data never goes away**

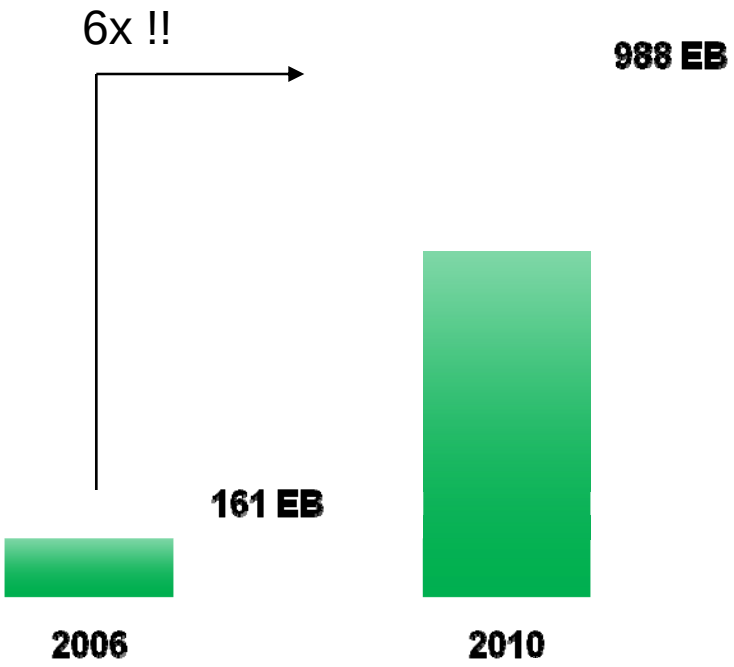
Issues

- **Power**
- **Space**
- **Heating/Cooling**
- **Longevity**
- **Reliability, Integrity**

Explosive Growth Challenging Infrastructure

Explosive Information Growth

Growth in Data Stored
2006 – 2010, Exabytes



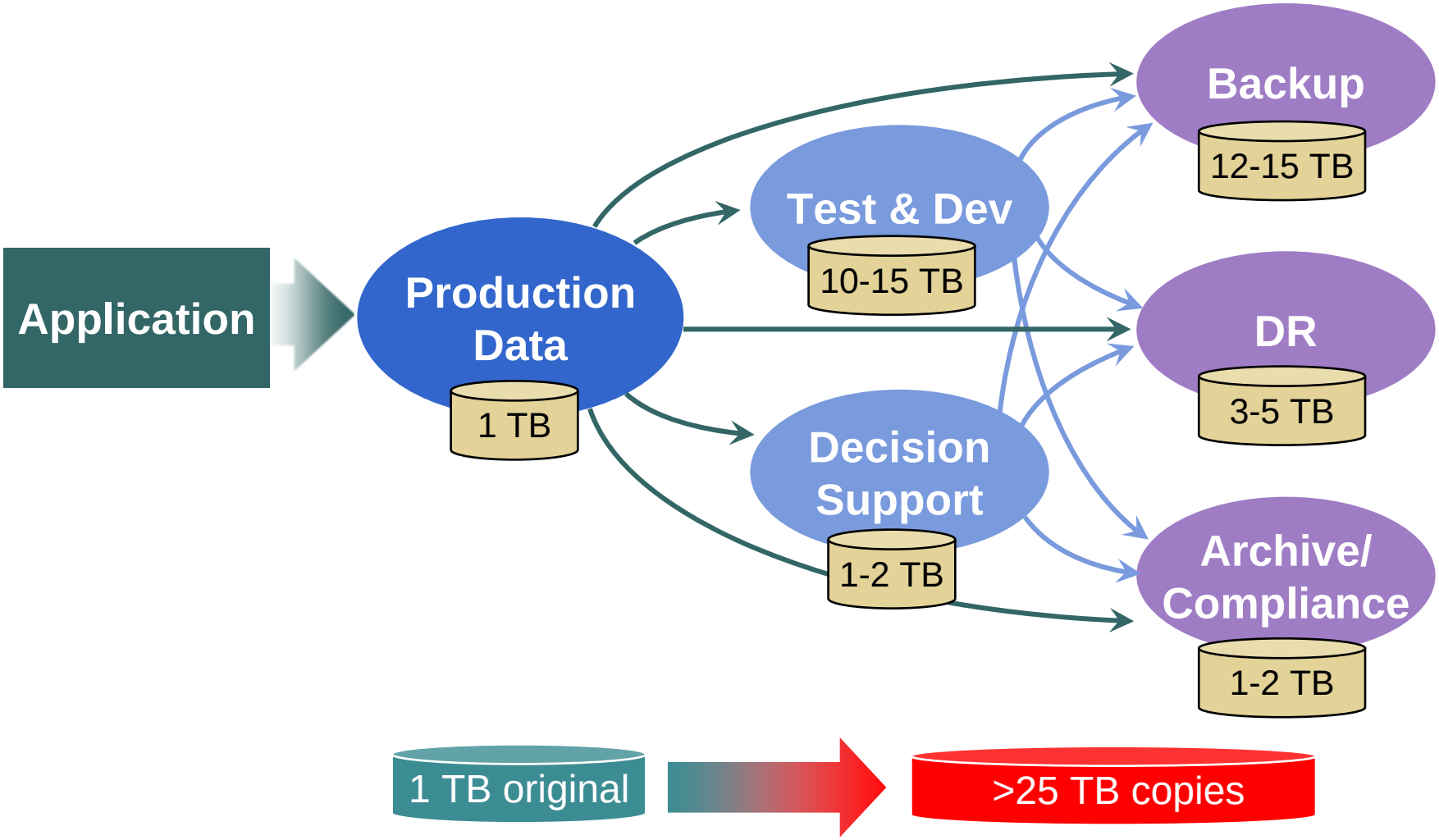
- **Information Explosion**
- **Most is unstructured**
- **Power is big TCO issue**

Source: IDC, *Digital Universe, 2007*

The Energy Challenge
A Balancing Act

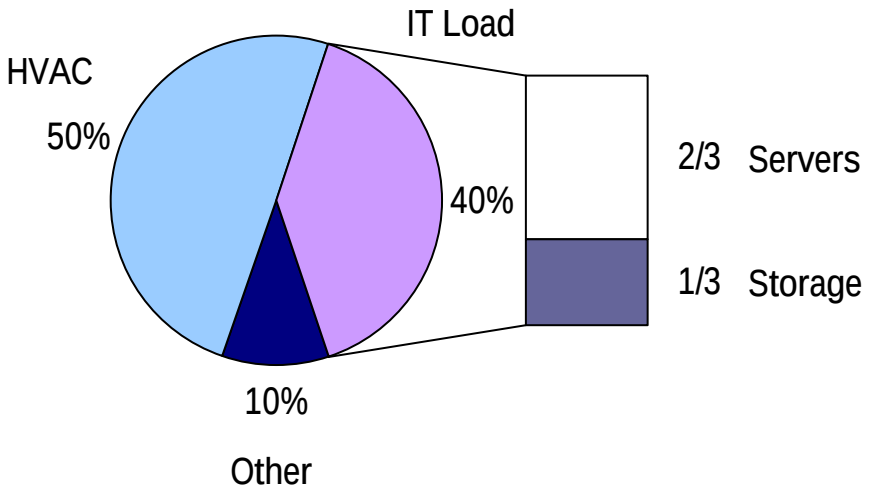
Power	**Heat & Cooling**	• Rack : 2Kw to 30 Kw (18 months) • 1Kw in = 1Kw out • Pushing datacenter limits
Availability	**Reliability**	• Lower MTBF • System instability • Unhappy customers
Cost	**Managing Growth**	• 38% of total budget today • Cost rising dramatically • Will slow growth long term
Social Responsibility	**Carbon Footprint**	• Growing corp. imperative • Social responsibility = tangible bus. benefits (ie lower TCO)

The Data Proliferation Problem



Data Center Economics

Typical Data Center Power Usage



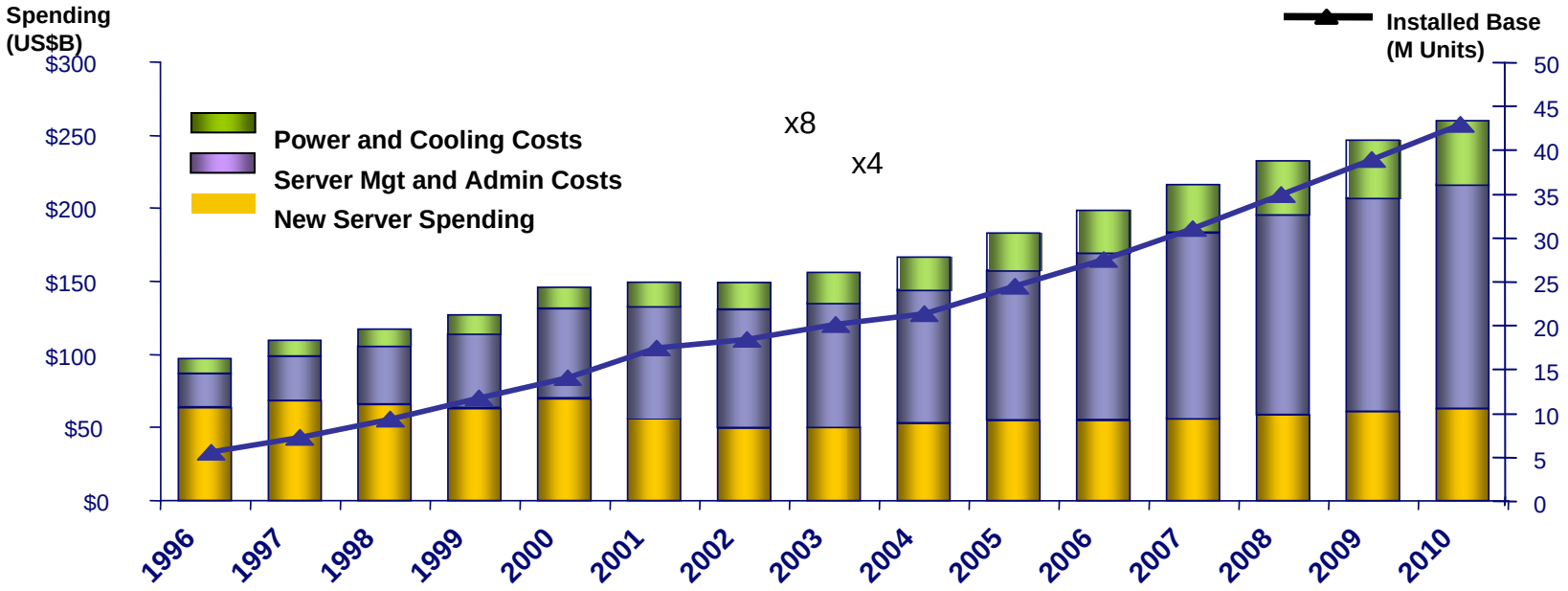
Additional Costs

- **Building a new 200 rack DC ($3 M)**
- **2 MVA Utility Power at 10 kw / rack ($0.5 M)**

- **Power Bills**
- **Capital Costs**

Economics - continued

WW IT Spending: Servers, Power /Cooling, and Mgmt



Source: IDC, Workloads 2006 (2007)

Power $$ will soon rival Server acquisition $$

* 330 W/shelf, 8736 hours/year, $0.13/KWh, 2x for HVAC, 500 GB SATA

What Can You Do Today?

8-Step Storage Power Diet

1. **Consolidate servers and storage**
2. **Use higher capacity drives**
3. **Protect against disk failures using fewer drives**
4. **Migrate data to more efficient storage**
5. **Increase utilization**
6. **Backups: do more with less**
7. **Eliminate storage overhead for test & dev**
8. **Measure your power efficiency**

Potential Savings From Key Levers

Illustrative – Your Mileage May Vary

Key Levers	Potential Savings **(Typical)**	
	Watts/Usable TB	↓ Rack Space
Consolidate/replace old systems	3x	☑
High Capacity HDDs	2-4x	☑
Deduplication	50%	☑
Thin Provisioning	33%	☑
Space Efficient Snapshots	33%	☑

Deduplication Examples

- **Surgical Equipment Manufacturer**
  - Archived file data
  - 38% space savings
- **Global Investment Manager**
  - Replicated VMware images
  - 88% space savings
- **Global Oil and Gas Company**
  - User home directories
  - 35% space savings
- **Test and Measurements Manufacturer**
  - Daily database backups
  - 98% space savings

Case Study: NetApp IT

Goals:

- Avoid $5M expansion
- Increase utilization
- Lower TCO
- Improve reliability

Solution:

- **Leverage Data ONTAP® 7G & FlexVol®**
- **Consolidate storage & increase utilization**

Benefits:

- **60% improvement in storage utilization**
- **Reduced storage systems from 50 →10**
- **Deleted >27TB of data**
- **80% power reduction**
- **Storage footprint from 25 to 6 racks**
- **Decrease heat load of 93 tons of A/C**
- **$59k/yr power cost reduction**

Case Study: Major Customer

Goals:

- Improve information access
- Rapid response to change
  - Capacity on demand model
- Reduce operational costs
  - ⬇ Datacenter footprint
  - ⬇ Power & cooling expenses

Solution:

- **Virtualized servers**
- **SAN with Thin-Provisioned Storage**
  - **Production and Test/Dev environments**

Benefits:

- **Replaced: 3103 Servers w/DAS storage**
  with: 134 Servers & 5 SANs
- **Replaced: 700 racks at 8 sites**
  with: 40 racks at 5 sites
- **Backup window from 96 hrs →15 - 31 min!**
- **LUN backup w/SnapMirror in 2-3 sec**
- **Power savings >$2.4M/year**

Copyright © 2007 Network Appliance, Inc. All rights reserved.

Summary

- ✓ **Runaway Data**
  = Runaway power & space issues
- ✓ **Critical issue for NetApp & Our Customers**
- ✓ **Lots you can do TODAY**

Thank You !